CANADA AND INTERNATIONAL SAFEGUARDS

Verifying Nuclear Non-Proliferation

External Affairs and International Trade Canada

Canada

"Canada was the first country with substantial nuclear capability to renounce the nuclear weapons option. Successive Canadian governments have chosen to devote their efforts instead to the development of the non-explosive uses of nuclear energy, to peaceful nuclear commerce and to strengthening the international non-proliferation regime.

As an original party, Canada strongly supports the full application of the NPT. . . . Canada has consistently and repeatedly called on those states not yet party to the NPT to accede as soon as possible. Canada has also taken a leading role in supporting other important elements of the international non-proliferation regime, such as the International Atomic Energy Agency (IAEA) safeguards system and multilateral nuclear export controls."

The Right Honourable Joe Clark,
Secretary of State for External Affairs,
Writing in *Maclean's Magazine*, 12 June 1989.

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Introduction

The discovery of nuclear fission marked its 50th anniversary in 1989. It has been an eventful 50 years. The advent of nuclear energy has meant significant medical, agricultural and industrial benefits as well as a clean, safe and economic source of electrical power. At the same time, the tremendous destructive force that can result from nuclear fission has caused deep fears over the consequences of the spread of nuclear weapons.

A desire to promote the peaceful uses of nuclear energy combined with concern about nuclear weapons proliferation provided the impetus for the international community to conclude the Treaty on the Non-Proliferation of Nuclear Weapons in the late 1960s. The Non-Proliferation Treaty (NPT) is the most widely supported arms control agreement in existence. It represents a high-point in the history of nuclear endeavours and has become the cornerstone of peaceful nuclear commerce, particularly for countries such as Canada.

Despite the NPT, however, concern about the spread of nuclear weapons still exists. A number of countries with nuclear programs have yet to sign the agreement. Furthermore, the possibility always exists that nuclear material used in peaceful nuclear research and the electricity-generating industry could be diverted by any country, even one that has signed the Treaty, to develop a nuclear explosive device. Guarding against this latter possibility requires effective verification.

It is only reasonable that countries that sign an arms control agreement will want some means of determining whether or not other countries are abiding by their commitments. In the case of nuclear non-proliferation — and in particular the NPT — this critical job of providing independent assurance that nuclear material used for peaceful activities is not diverted to illicit purposes, is primarily undertaken by the International Atomic Energy Agency (IAEA) through its nuclear safeguards systems. The efforts of the IAEA in this area provide an outstanding example of effective multilateral co-operation, particularly in the field of verification.

Canada, which has long been a strong proponent of the international non-proliferation regime based on the NPT and verified by the IAEA, will continue its active involvement. As the Right Honourable Joe Clark, Secretary of State for External Affairs stated in a news release on July 28, 1988

to commemorate the 20th anniversary of the NPT:

> *The [Treaty's] continuing major importance has been that it provides for legally binding commitments to prevent the proliferation of nuclear weapons and facilitates international co-operation in the peaceful uses of nuclear energy. . . . The [Treaty], which has already made major contributions to non-proliferation, will continue to be a vital factor in strengthening international security and co-operation.*

This brochure will explore some of the background to IAEA safeguards and outline how they work. It will also examine Canada's contributions in this area which have been and remain very significant.

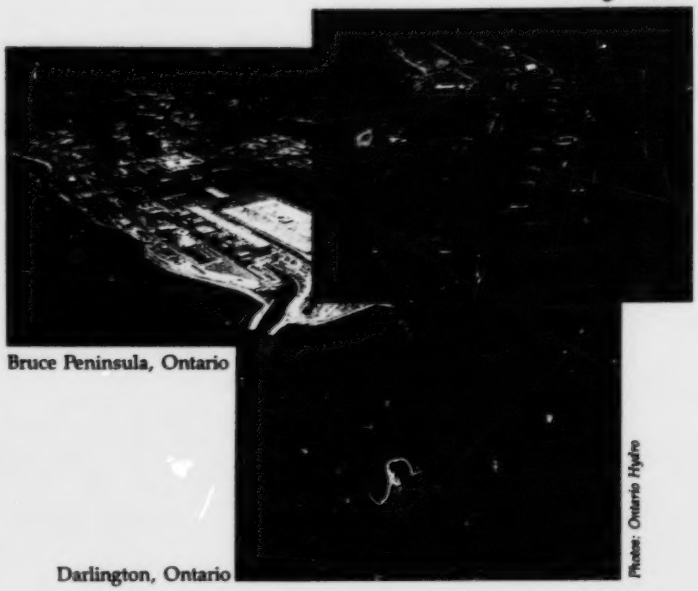
Figure 1 The IAEA Model

The IAEA safeguards system is often cited as a general example of a functioning verification system that could be emulated in other areas of arms control. Clearly, the IAEA system cannot be transferred without change to other areas, if only because of the special nature of the nuclear industry for which safeguards are designed, and the unique history of the IAEA. Nevertheless, it is also clear that the success of safeguards provide a number of lessons upon which the designers of verification schemes in other arms control fields can draw. For example, organizational, legal, financial and technical aspects of the Agency's experience can provide valuable insight for efforts to develop a regime for verifying a ban on chemical weapons.

Perhaps the most significant lesson that the experience of IAEA safeguards can teach is that verification by an independent international agency through on-site inspections and associated intrusive techniques, in sensitive areas of commercial activity, is not only feasible, but can be made to work both effectively and efficiently. The specifics of how a particular multilateral arms control agreement is verified is a matter for the parties of that agreement to decide. One viable option, however, which should not be overlooked when making such decisions, is the approach demonstrated by IAEA safeguards.

Figure 2 Some Peaceful Uses of Nuclear Energy

Electric Power Generation



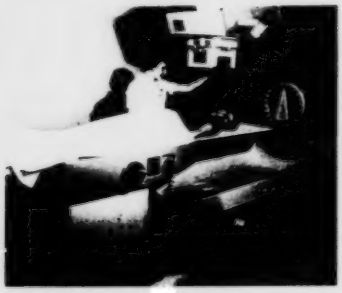
Pickering, Ontario

Bruce Peninsula, Ontario

Darlington, Ontario

Photos: Ontario Hydro

Medicine



Cobalt 60 cancer treatment.

Radioisotopes for diagnostics.

Photos: AECL

Chapter 1

The Evolution of Nuclear Non-Proliferation Safeguards

Canada's Role in International Safeguards

Since the end of the Second World War, successive Canadian governments have been profoundly interested in the development and control of nuclear energy. In 1945 the *Declaration on Atomic Energy by the United States, United Kingdom and Canada* established two principles that have remained central to Canadian policy: the desire to prevent nuclear weapons proliferation and the need for international co-operation to promote the peaceful use of nuclear energy. This declaration was paralleled within Canada by the *Atomic Energy Control Act* of 1946, the preamble of which states: "it is essential in the national interest to make provision for the control and supervision of the development, application and use of atomic energy, and to enable Canada to participate effectively in measures of international control of atomic energy which may hereafter be agreed upon...." Although not entirely foreseen at the time, the *Atomic Energy Control Act* has enabled Canada to pursue nuclear policy objectives both nationally and internationally for over 40 years.

International nuclear commerce began in a meaningful way after the convening in August 1955 of the First International Conference on Peaceful Uses of Atomic Energy held in Geneva under United Nations auspices. It was here that the nations possessing nuclear technology indicated a willingness to share all but the most sensitive technology with others, but only for peaceful uses. Because no internationally agreed verification measures were in place at the time, early agreements between supplier and recipient countries covering transfers of nuclear items included procedures designed to verify that the peaceful uses commitment was being honoured. This was the first occasion that international nuclear co-operation agreements contained provisions designed to verify compliance, including on-site inspections. The term "safeguards," first coined in 1945, came to be used to describe these verification measures.

These bilateral safeguards arrangements continued on their own until 1957 when the International Atomic Energy Agency (IAEA) was founded. The IAEA was given two roles: the promotion of the benefits of nuclear energy and the establishment of a system of international safeguards. The first IAEA safeguards system

Table 1 Key Dates in Nuclear Non-Proliferation

July 16, 1945	Detonation of first U.S. nuclear explosive device.
August 6, 1945	Dropping of nuclear bomb on Hiroshima, Japan.
November 15, 1945	Joint Declaration of the Heads of Government of the United States, the United Kingdom and Canada calling for international action: (a) to prevent the use of atomic energy for destructive purposes, and (b) to promote the use of recent and future advances in atomic energy for peaceful and humanitarian ends.
September 23, 1949	Detonation of first Soviet nuclear device.
October 20, 1952	Detonation of first U.K. nuclear device.
December 8, 1953	"Atoms for Peace Proposal" by President Eisenhower calls for establishment of an International Atomic Energy Agency under UN sponsorship and for world-wide sharing of peaceful uses of nuclear energy.
October 26, 1956	Statute of the International Atomic Energy Agency opened for signature. The Statute came into force on July 29, 1957.
October 16, 1960	Detonation of first French nuclear device.
January 31, 1961	First IAEA safeguards system approved covering small reactors (INFCIRC/26). First inspection under this system took place in 1962.
August 5, 1963	Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (Limited Test Ban Treaty) opened for signature. Entered into force on October 10, 1963.
October 16, 1964	Detonation of first Chinese nuclear device.
September 28, 1965	New safeguards system approved covering all sizes of reactors (INFCIRC/66).
February 14, 1967	Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco) opened for signature. Entered into force on April 22, 1968.
July 1, 1968	Treaty on the Non-Proliferation of Nuclear Weapons opened for signature. Entered into force March 5, 1970.

March 10, 1971	NPT safeguards system approved (INFCIRC/153).
May 26, 1972	Interim Agreement on the Limitation of Strategic Offensive Weapons (SALT I) signed by U.S. and U.S.S.R. Entered into force October 3, 1972.
June 2, 1972	Agreement between Canada and the IAEA on the application of NPT safeguards in Canada approved by the IAEA Board of Governors (INFCIRC/164).
May 8, 1974	Detonation by India of nuclear device.
September 3, 1974	First publication of the results of Zangger Committee on export controls (INFCIRC/209).
September 21, 1977	Nuclear Suppliers' Group Guidelines agreed (published as INFCIRC/254).
June 18, 1979	Treaty between the U.S. and U.S.S.R. on the Limitation of Strategic Offensive Arms (SALT II) signed. Never ratified by U.S.
August 6, 1985	South Pacific Nuclear Free Zone Treaty signed. Entered into force on December 11, 1986.
December 8, 1987	Treaty on the Elimination of Intermediate-Range and Shorter-Range Missiles (the INF Treaty) signed by U.S. and U.S.S.R. Entered into force on June 1, 1988.

was introduced in 1961 covering small electric power reactors up to 100 megawatts capacity. A revised system covering all reactors was introduced in 1965 and in 1966 it was extended to include nuclear fuel reprocessing plants. Provisions covering conversion and fabrication plants were added in 1968. Throughout this period, Canada was deeply involved in this process of developing the IAEA and its safeguards systems.

In February 1957, Canada announced its willingness to negotiate bilateral co-operation agreements with friendly countries. The agreements would cover, in particular, the supply of natural uranium for peaceful uses under safeguards provisions similar to those envisaged for the IAEA. Under such co-operation agreements, staff from Canada's Atomic Energy Control Board were able to carry out inspections of exported Canadian uranium and to verify fulfilment of undertakings with respect to peaceful uses. Although uranium exports were highlighted in these and earlier policy statements, the peaceful purposes requirements, with attendant safeguards measures, applied to reactor and other nuclear exports as well.

It was later in this period that the government made the decision that Canada would no longer supply materials to the nuclear weapons programs of its allies. In 1965, Prime Minister Lester B. Pearson announced in the House of Commons that:

> *As one part of its policy to promote the use of Canadian uranium for peaceful purposes the government has decided that export permits will be granted, or commitments to issue export permits will be given, with respect to sales of uranium covered by contracts entered into from now on, only if the uranium is to be used for peaceful purposes. Before such sales to any destination are authorized the government will require an agreement with the government of the importing country to ensure with appropriate verification and control that the uranium is to be used for peaceful purposes only.*

After this time, every activity in the Canadian nuclear community was conducted exclusively for peaceful purposes.

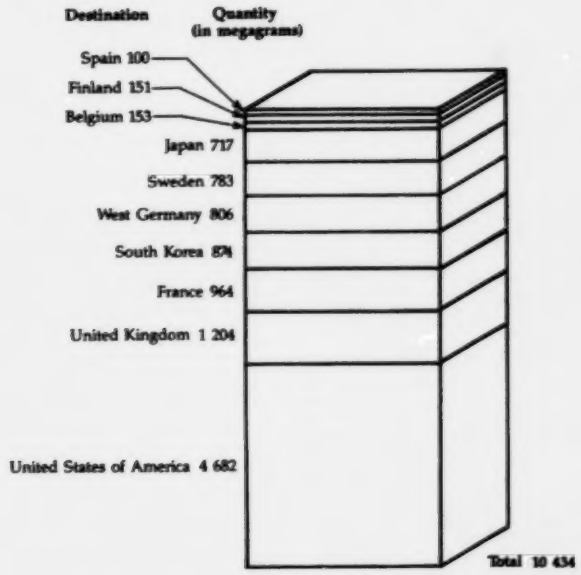
Exporters and importers alike recognized that nationally administered safeguards lacked the credibility of international ones. Thus, as the IAEA's safeguards system developed, arrangements were made to transfer Canadian bilateral safeguards responsibilities to the Agency.

Figure 3 Canadian Uranium Exports for 1988

SSC/ASC

AECL

AECL



During the late sixties, Canada and the United Kingdom worked in concert with the United States in the international drafting of the NPT and in the safeguards system that the IAEA now uses to verify compliance with that treaty. This partnership gave Canada a strong voice in the negotiations that led to the final treaty.

Under the NPT, which came into force on March 5, 1970, member countries, including Canada, that did not possess nuclear weapons, were required to conclude an agreement with the IAEA for the application of safeguards to all nuclear material in all peaceful nuclear activities. These countries are commonly referred to as "non-nuclear weapons states." A model NPT safeguards agreement[1] was drawn up by the IAEA and approved by its Board of Governors before the end of 1970. Agreements based on this model are now applied in some 100 countries including most of those having significant nuclear activities. Canada and the IAEA concluded negotiations on a safeguards agreement in February 1972, at which time inspection of Canadian facilities commenced. The safeguards to be applied under these NPT agreements are for the exclusive purpose of verifying that all nuclear material in all peaceful nuclear activities within the territory of the signatory state "are not diverted to nuclear weapons or other nuclear explosive devices."

Following the entry into force of the NPT, Canada continued to work with other nations to develop guidelines to be used by major nuclear suppliers when exporting nuclear material, equipment or technology to non-nuclear-weapons states. During 1971 and 1972, a group of states, including Canada, that were actual or potential suppliers of nuclear items, met to establish a consensus on items that would trigger safeguards under the terms of the NPT. This group was designated as the NPT Exporters' Committee but is commonly referred to as the Zangger Committee. A consensus, the so-called "Zangger List," was established with respect to material and equipment that would trigger NPT safeguards if exported to non-nuclear weapons states. In 1974, Canada indicated that it would act in accordance with that consensus.

Canada's non-proliferation policy was reviewed after India's "peaceful nuclear explosion" in

1. "The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons," Document *INFCIRC/153*, June 1972.

Figure 4 Bilateral Nuclear Co-operation Agreements

Canada has concluded bilateral agreements meeting the requirements of the December 1976 policy statement on the peaceful uses of nuclear energy with the following countries and organizations:

- Australia
- Colombia
- Egypt
- EURATOM (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom)
- Finland
- Hungary
- Indonesia
- Japan
- Korea
- Philippines
- Romania
- Sweden
- Switzerland
- Turkey
- Union of Soviet Socialists Republics
- United States
- Uruguay

Except for nuclear weapons states, these agreements require that IAEA safeguards will apply to the whole nuclear program in each country (including Canada) thus eliminating the need for Canada to conduct inspections.

Also, limited bilateral agreements have been signed with a number of countries on certain specialized exports.

May 1974. More stringent safeguards covering the export of Canadian nuclear material, equipment, facilities and technology to all countries, whether they possessed nuclear weapons or not, were announced on December 20, 1974. These additional non-proliferation assurances and controls must be accepted in a formal bilateral agreement with Canada before nuclear exports can go ahead. From 1974 to 1976, examination of the policy continued and in December 1976 the government announced that any new nuclear co-operation would be authorized only for non-nuclear weapons countries that had either ratified the NPT, and thereby accepted IAEA safeguards on all their present and future nuclear activities, or made an equally binding commitment to non-proliferation by accepting NPT-type full-scope safeguards.

One repercussion of the Indian nuclear explosion was the impetus given to consultations among the world's major nuclear technology exporters, who became known as the Nuclear Suppliers Group (NSG). While Canada failed to obtain the agreement of the Group to impose rigid controls like those applied to Canadian nuclear exports, a set of "Guidelines for Nuclear Transfers" did emerge in 1978 from these consultations which effectively ended significant transfers of sensitive nuclear technology to countries not accepting safeguards on the imported items. The NSG Guidelines require that IAEA safeguards cover any transfer of nuclear material, equipment or technology. They do not require the recipient country to join the NPT or make any equivalent commitment to non-proliferation. In 1978, the trigger list associated with the Zangger Committee was clarified in order to bring it into conformity with the NSG Guidelines.

The NSG Guidelines were a significant non-proliferation advance but left Canada with a more stringent set of non-proliferation requirements than the other major nuclear reactor vendors, who now pursue markets in a number of non-NPT countries that remain under a Canadian nuclear embargo.

International Atomic Energy Agency Safeguards

The IAEA defines safeguards practices as follows:

> *Safeguards practices can be summarized in one word: verification. To verify means 'to establish the truth of.' In safeguards, to verify is to establish the truth*

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Figure 5 Key Elements of Canada's Non-Proliferation Policy

- Nuclear co-operation will be authorized *only* for those non-nuclear weapons states that have made a general commitment to non-proliferation by either having ratified the NPT or having taken an equivalent binding step and that have thereby accepted IAEA safeguards on the full scope of their nuclear activities.

- Nuclear exports can go forward only to those states (both non-nuclear and nuclear weapons states) which have undertaken to accept in a formal agreement a number of additional requirements. These include:

  - an assurance that Canadian-supplied nuclear items will not be used in connection with the production of nuclear explosive devices;
  - a provision for fallback safeguards in the event that a situation arises where the IAEA is unable to continue to perform its safeguards functions;
  - control over the retransfer of Canadian-supplied nuclear items;
  - control over the reprocessing of Canadian-origin spent fuel, subsequent storage of the separated plutonium, and enrichment beyond 20 per cent U-235 of Canadian-origin uranium; and
  - an assurance that adequate physical protection measures will be applied.

- Support for measures aimed at the maintenance and strengthening of the existing nuclear non-proliferation regime based on the NPT. These include:

- the pursuit of the arms control and disarmament measures as provided for in the Preamble to and Article VI of the NPT;
- support for the IAEA safeguards program;
- exchanges with other NPT parties of information and materials relating to the peaceful uses of nuclear energy, subject to the above-mentioned limitations;
- active encouragement of non-NPT parties to accede to the treaty;
- active participation in the five-year NPT review conferences;
- in the absence of universal adherence to the NPT, encouragement of the establishment of nuclear-weapons-free zones where they command the support of the major powers in the area and contribute to regional and global security; and
- participation in the Missile Technology Control Regime as an important adjunct to the NPT.

of statements regarding the amounts, presence and use of nuclear material or other items subject to safeguards as recorded by facility operators and as reported by the state to the IAEA. Accountancy, taken together with containment and surveillance, is the fundamental basis on which verification rests."[2]

The main political objectives of safeguards are to:

- gain assurance that countries are complying with their non-proliferation and other peaceful use undertakings; and
- deter the diversion of safeguarded nuclear materials to the production of nuclear explosives and the misuse of safeguarded facilities to produce unsafeguarded nuclear material.

To achieve these political objectives, the IAEA has set itself the technical objective of the "timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or other nuclear explosive devices or for purposes unknown and deterrence of such diversion by risk of early detection."[3] The "significant quantity" of nuclear material used by the IAEA as their detection target is 8 kg of plutonium or 25 kg of highly enriched uranium. These are the amounts required to manufacture a nuclear explosive device. "Timely detection" derives from the time required to convert diverted material into components for an explosive device.

To meet this technical objective, the IAEA has established a process for verifying the continued presence of nuclear material placed under safeguards. This process consists of comparing the accuracy of reports and other information provided by a country against independent, objective information collected by IAEA inspectors and from containment and surveillance equipment such as cameras and seals installed by the IAEA at the country's nuclear facilities.

Safeguards agreements between a country and the IAEA concluded as a result of the NPT require the country to establish and maintain a State System of Accounting for and Control of Nuclear Material within its territory. IAEA verification is based on reports submitted by the country, as well as on records kept at facilities, such

continued on page 33

2. *IAEA Safeguards: An Introduction*, Vienna: International Atomic Energy Agency, 1981, p. 19.

3. *INFCIRC/153*, June 1972, paragraph 28.

Figure 6 Safeguards As Seen Through the Eyes of a Canadian Former IAEA Inspector — Mr. Allen Rose

Although the next inspection trip is three weeks away, there is little enough time to prepare. A trip of three weeks will entail inspections at perhaps nine different facilities and cover perhaps three different countries. The itinerary is never the same two trips in a row. Travel and accommodation arrangements have to be made. Visas have to be obtained. Immunization has to be looked into. Fortunately, the IAEA has an excellent support staff for looking after the details but you have to tell them where and when.

With that taken care of, the actual inspection task can start. Some of the facilities involved will likely be new to you. Facility design information must be obtained from the Agency's registry and studied to the point of familiarity. You must appear to know what you are doing in front of the operator; otherwise his superiors will hear about it and so will yours. It is vital for co-operation not to waste the operator's time. After all, you're not a productive element in his day.

Once the facilities' designs are familiar, it's time to recall the reports from the last inspection. These tell you what procedures were followed by the last inspector. A co-operative operator will have the necessary documentation ready for you on the basis of what happened last time. The past reports tell you two things. First, the hard facts of inventories, material types and locations, and the instrumentation required to verify the numbers. Second, the unofficial notes of the previous inspector. Sometimes the

numbers all add up but the inspector has a gut feeling that something is not right. Maybe it's just that the facility's accountant seemed unusually nervous. Not the kind of thing reportable as fact but enough to suggest that the next inspector (you) should allow time for a more thorough review of the books than usual.

Finally, instruments must be requisitioned from stores for whatever type of inspection is called for. Some inspections are routine checks; for instance, an operating reactor where nothing has changed will require only verification of some seals. Others require physical inventory of complex chemical compounds of nuclear material. Special procedures for each facility have been designed by the IAEA to examine all the possible diversion paths. The instruments have to be checked out and calibrated, equipment for taking samples has to be obtained, procedures for reviewing surveillance devices have to be reviewed. And then there are the maintenance requirements for installed IAEA instrumentation.

On the road finally. First stop is usually the capital of the country being inspected. Perhaps a 24-hour layover in Bangkok or Hong Kong is required if the trip is long. Fascinating the first time, but the 21st time...? After a short night at a hotel, a meeting with the country's regulatory authority is first on the itinerary to review plans for the various inspections. Then it's on board a train for the ride to the first inspection site. This night is spent in a charming traditional country inn overlooking the sea. Very beautiful except that it is January with no heating.

The next morning is spent at a power reactor that has operated without pause since the last inspection. A routine check of seals and surveillance films takes two hours

and then on board a local train (no glass in the windows, families complete with livestock) for a trip up the coast to another similar inspection. Four days travel; four hours of work. But then, this is not a job paid by the hour.

Next a different facility, a different kind of management, a complicated physical inventory in which six inspectors are involved. The manager is very polite. He invites you into his plant and says please do what you wish and then leave. Nothing is prepared. No staff is available to help. What is going on? Is the plant in violation of its commitments or did the last inspection team annoy the manager without even realizing it (there was no mention in the report)? What to do? For the inspector there is no easy answer. If you cancel the inspection, you waste valuable time and money. Perhaps this will give the plant time to cover up a real violation. If you continue, the results are probably going to be unsatisfactory. The Agency will not be pleased; the regulatory authority will not be pleased. A possible violator may obtain the time needed to cover up.

Fortunately, most of these situations yield to diplomacy: the manager finally agrees to co-operate and in fact everything is in order. And what if everything is not? Well, that is a situation with which inspectors hope they will never have to deal. So far that has been the case. Of course, errors are found, as happens in any audit, but these are generally resolved and most often do not involve significant quantities of material. It is like the staff of a bank working overtime to balance a one dollar discrepancy; the amount is not important but the error is.

After a week in one place for such a major inventory it is back on an aircraft for a

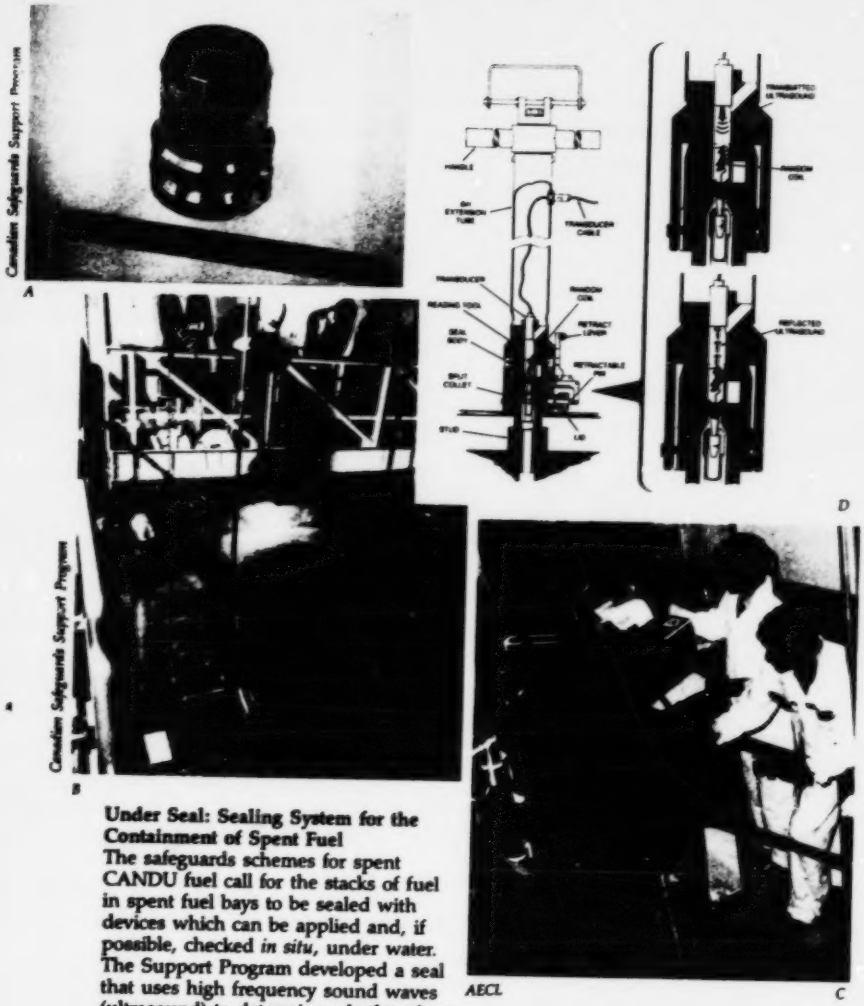
week or two in another country, perhaps where it is summer instead of winter. A complete change of climate. A complete change of food. Probably intestinal problems before you can finally board that last flight back to Vienna and family.

Of course the inspection work is not quite over. On return to the office there is a debriefing to go through with the Section Head and other inspectors. What went right? What went wrong? Were the decisions taken on-site the best or would some other action have been more effective?

Then there is the routine of filling in the numerous reports. The Agency has complete records of all the transactions between all the facilities under its jurisdiction. None of these facilities operates in isolation. Computers compare your reported results with all of its stored information to verify that it all adds up. If not, then you have a follow-up job to do before this inspection is over. It makes no difference to the computer whether the error is the operator's or yours, you still have to track it down, and explain why you didn't catch it in the field, where it should have been resolved in the first place. This is not something any inspector looks forward to but the result is important, not individual feelings. In such a system a lie has to be consistent throughout the whole network of facilities or it will come to light. This is the key to the effectiveness of safeguards that entirely cover the nuclear programs of the member countries.

The reward comes each year in September at the general conference of the IAEA's member countries when the Director General can announce that the inspection system has once again been able to assure the world that no nuclear material under safeguards has been diverted to weapons use.

Figure 7 Equipment Developed Under the Canadian Safeguards Support Program



Under Seal: Sealing System for the Containment of Spent Fuel

The safeguards schemes for spent CANDU fuel call for the stacks of fuel in spent fuel bays to be sealed with devices which can be applied and, if possible, checked *in situ*, under water. The Support Program developed a seal that uses high frequency sound waves (ultrasound) to determine whether the integrity of the seal has been breached (A). These seals are installed using a long rod (B) and can be routinely checked by inspectors using a special Seal Pattern Reader (C). Each seal contains a wire coil. When an ultrasonic wave is sent to the seal, the coil creates a unique reflection pattern which is destroyed if the seal is tampered with or removed (D). The seal has been accepted for routine use by the IAEA, making this the first application of an underwater *in situ* verifiable seal anywhere in the world.

Under Surveillance: Television Surveillance Systems

This highly sophisticated computerized television surveillance system records views from eight separate cameras onto one video-tape. The information on the tape can be easily retrieved for review by inspectors. Several units have been purchased from AECL for installation at non-CANDU facilities. Other units have already been installed at CANDU reactor sites in Canada and overseas.

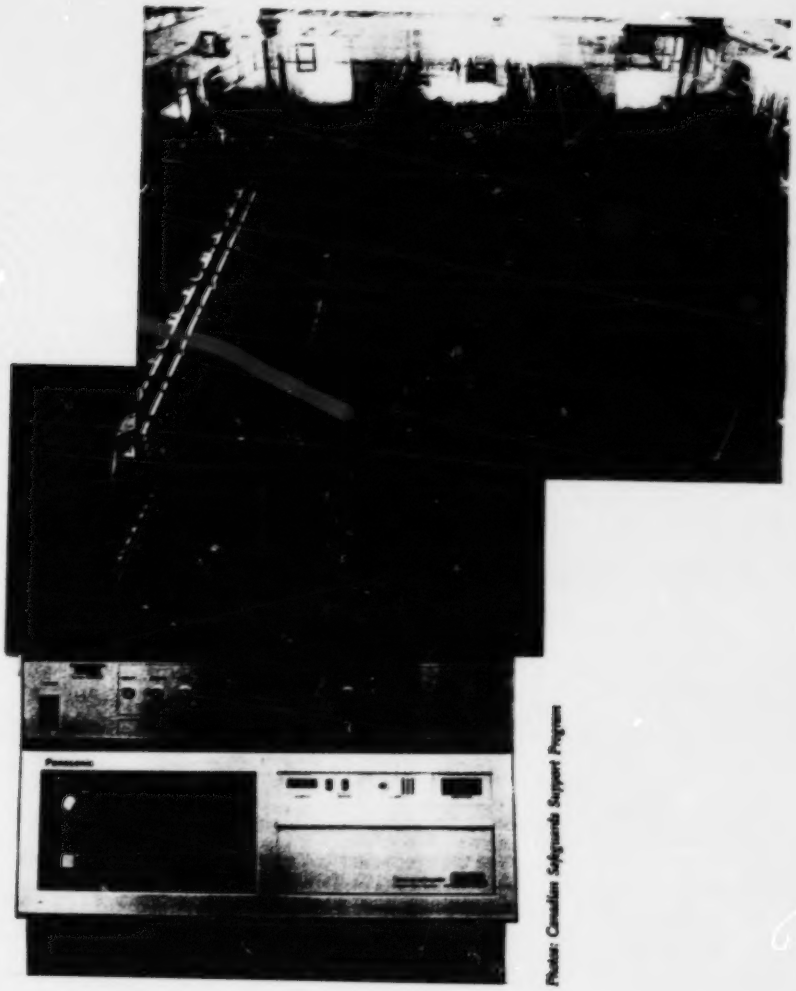


Photo: Canadian Safeguards Support Program

adiated Fuel Bundle Verifier
n instrument with which to reverify e presence of spent fuel was devel- ed for use in the event that ntinuity of surveillance in the spent el bay is interrupted. Prototype ...uments — which are actually ht-intensifying devices for observing e blue glow given off by irradiated el in water — have been purchased, odified, tested and given to the EA. Non-CANDU applications r these instruments have already en identified.

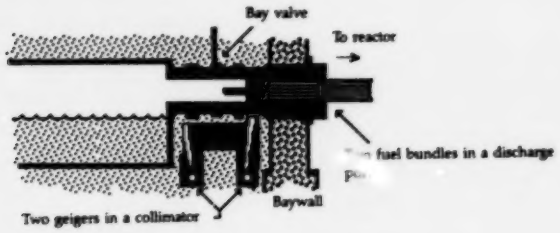
View through scope

Photo: Canadian Safeguards Support Program

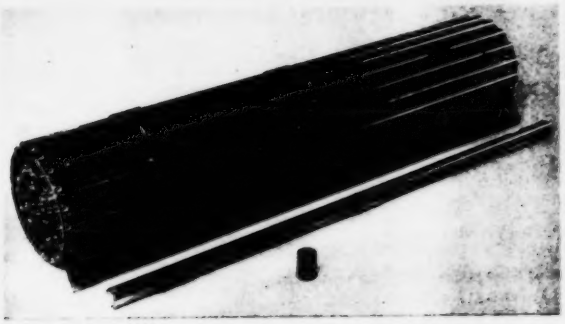
Core Discharge Monitor
The approach to safeguards at multi-unit CANDU stations involves a device known as a core discharge monitor which records all movement of fuel out of the core of the reactor. The first of these has been installed at the Darlington CANDU reactor station. (Not illustrated).

Counting Spent Fuel Bundles

Bundle counters developed by the Support Program are the primary means of counting and verifying spent nuclear fuel bundles as they pass from the reactor into storage in water-filled bays. There are counters installed at CANDU reactors in five countries (Canada, India, Pakistan, Argentina and Korea) and four others are in the process of being installed at CANDU reactors in Canada. At the request of the IAEA, attention is now being given to upgrading the design, to take account of advances in technology and to incorporate features not originally required.



The transfer of a test and training version of a spent fuel bundle counter to the IAEA is shown in this photo from May 12, 1983. Mr. Alan Sullivan, then Ambassador of Canada to Austria, is on the right and Dr. Hans Blix, Director General of the IAEA is on the left.



Fuel Bundle

Photo: Canadian Safeguards Support Program

as electric power plants, that are under safeguards. It is the responsibility of the country to ensure that facility operators comply with the requirements of the safeguards agreement. These requirements include proper and accurate record keeping and reporting according to an agreed format. The country must also ensure the equipment at facilities for measuring the quantity and composition of nuclear material is up-to-date. In addition, the country is responsible for ensuring that IAEA inspectors are granted all necessary access to facilities and material and for providing the support they require to carry out their duties effectively. This may include assisting the inspectors in applying containment and surveillance and other measures at nuclear facilities.

Three distinct stages occur in the verification process as defined by the IAEA:

- Examination of information provided by the country concerning installation design, nuclear material accounting records, clarifications of reports and advance notifications of international transfers.

- Collection of information by the IAEA itself through inspections.

- Evaluation of the information provided by the country and that collected by the Agency to verify the completeness, accuracy and validity of the information provided by the country.

Safeguards agreements are implemented by three IAEA operations divisions (see Figure 8), each of which has responsibility for a specific region of the world. Each division is made up of inspectors and support staff and is responsible for planning and performing safeguards inspections.

The safeguards operations divisions are supported by other organizational units within the IAEA that deal with the general development of safeguards approaches and the development of equipment for measurement, analysis and surveillance. Data processing and evaluation of inspection activities are equally important functions as are equipment maintenance and training. The IAEA also maintains a safeguards analytical laboratory for the analysis of nuclear material samples taken by inspectors. The IAEA does not, however, have the resources to operate a dedicated research and development facility and is, therefore, dependent on the support programs presently undertaken

by several member countries, including Canada.

Limitations Under Which the IAEA Must Operate

There are limitations and practical constraints in the application of NPT safeguards under which the IAEA must operate:

- The IAEA has no power to compel any country to sign any treaty or agreement. All safeguards agreements are entered into at the request of the country concerned.
- All NPT safeguards agreements are essentially identical and are based upon the model drawn up in 1970. Earlier bilateral agreements, however, permit greater flexibility. Extensive negotiations have taken place to standardize, as much as possible, these two systems.
- The IAEA's authority is limited to verifying "that the state is carrying out its safeguards obligations." If the IAEA finds that a country is not complying with a safeguards agreement, the Board of Governors must report the non-compliance to all members of the IAEA and to the Security Council and the General Assembly of the UN.
- A country's failure to report all nuclear material in all its peaceful nuclear activities would be a breach of its safeguards agreement. The IAEA inspectors do not have the right, however, to search a country for unreported material or facilities.

Within these constraints and the financial limitations set by the member countries who decide the IAEA budget, the IAEA has maintained a very credible and effective safeguards system.

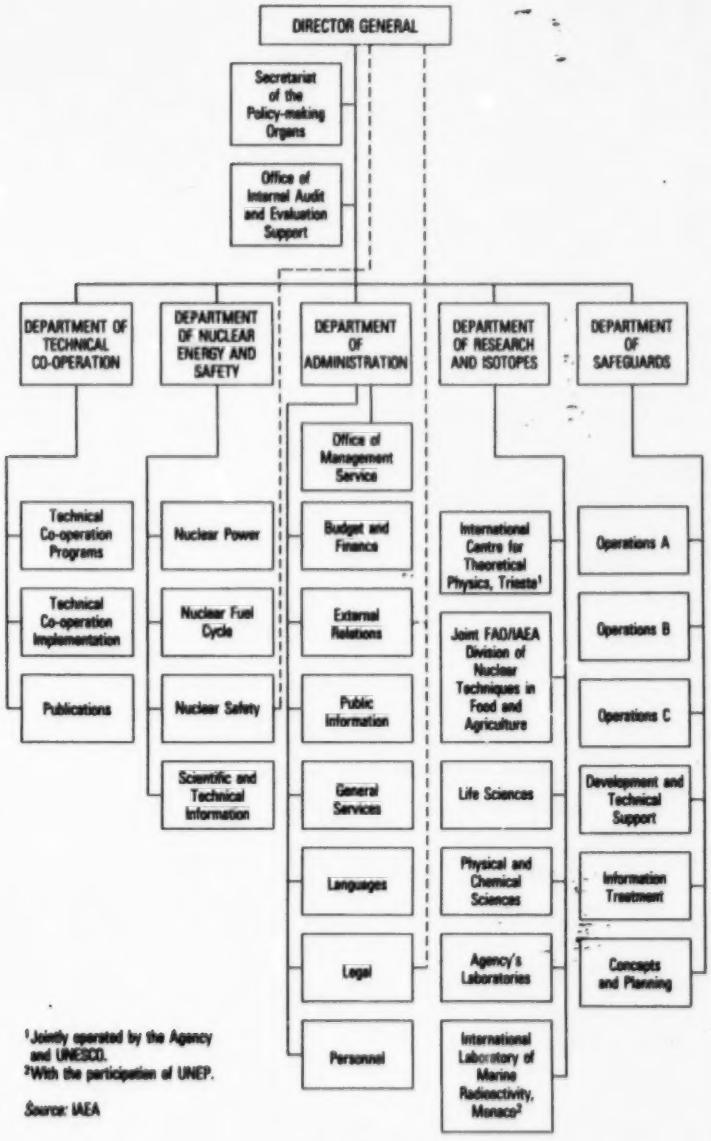
Safeguards are still evolving and incorporating advances in technology to improve containment, surveillance and other techniques. The system is not perfect and there remain many political, legal and technical difficulties to surmount. While the cost of safeguards is appreciable — the IAEA's annual safeguards budget for 1988 was US$47.5 million, out of a total budget of US$147 million — it is a very small burden to be borne compared to the considerable contributions to international security that IAEA safeguards provide.

Table 2 Growth of the IAEA

IAEA				
Year	1966	1976	1986	1988
Total IAEA Expenditures (Actual Obligations) ($US millions)	8.9	35.4	114	147
IAEA Total Staff	731	1 232	1 994	2 079
SAFEGUARDS				
Number of Inspections	29	565	2 050	2 128
Number of Installations Under Safeguards**	55	332	910	920
Safeguards Division Expenditures	0.4	5.9	39.9	47.5
Safeguards Division Total Staff	(24)*	138	455	476

* Figure is for 1967.
** This figure includes "locations outside facilities containing small amounts of safeguarded material."
Source: Various IAEA Documents.

Figure 8 Organization Chart of the IAEA



[1] Jointly operated by the Agency and UNESCO.
[2] With the participation of UNEP.

Source: IAEA

Chapter 2

Canada and IAEA Safeguards

In Canada, control over nuclear energy is a federal responsibility. The Atomic Energy Control Board (AECB) administers Canada's domestic and international safeguards commitments under the authority of the *Atomic Energy Control Act*. Under this Act, the AECB:

- establishes regulations for possession, transfer (both domestic and international) and use of nuclear materials; and
- institutes an accounting and control system which has two objectives:
  (1) A national objective to account for and control nuclear material in Canada, thereby detecting possible losses and unauthorized use or removal of nuclear material.
  (2) An international objective to provide the necessary basis for the application of IAEA safeguards.

In conjunction with the IAEA and facility operators, the AECB establishes and monitors Material Balance Areas within individual Canadian nuclear facilities. All nuclear material transfers — incoming and outgoing — can be accounted for as they pass through these areas. As well, a physical inventory can be taken to establish a nuclear material balance.

Additionally, the AECB:

- acts as Canada's point of contact with the IAEA on safeguards matters;
- evaluates the information provided by the facilities and prepares reports for the IAEA; and
- ensures that the objectives for nuclear material accounting and control are met.

Domestic Safeguards

The Safeguards and Security Division of the AECB provides both support for and information to the IAEA to fulfil Canada's obligations under the NPT. Safeguards procedures required by the Treaty are set out in an agreement between the Government of Canada and the IAEA. The Division co-ordinates arrangements between the IAEA and Canadian nuclear facilities for Agency inspections and accompanies IAEA inspectors on all physical inventory verifications. During 1988, for example, the IAEA conducted 149 safeguards inspections at 28 Canadian facilities requiring 744 IAEA inspector-days. At the end of 1988, 36 IAEA inspectors were designated for Canada.

The Canada/IAEA agreement also requires that Canada establish and maintain a national system of accounting for and control of all nuclear material subject to safeguards under the agreement. To fulfil this undertaking, the Safeguards and Security Division collects data on all nuclear material movements in Canada and subsequently provides reports to the IAEA. A computerized system collates data from all facilities on nuclear material transfers and inventories and puts the data into suitable formats for transmission to the Agency. During 1988, 508 reports involving 13 422 transactions were dispatched to the Agency's headquarters in Vienna. Since the Canada/IAEA agreement came into force in 1972, some 7 000 such reports have been sent to the Agency.

Other functions of the Division are to provide advice to External Affairs and International Trade Canada on safeguards and non-proliferation matters, to participate in annual consultations between Canada and the IAEA, and to meet formally once or twice per year with the appropriate operations division of the IAEA responsible for maintaining safeguards on nuclear facilities in Canada. Working contact with the operations staff of IAEA is continuous.

International Safeguards

The Safeguards and Security Division of the AECB also operates a system of accounting for and control of exports of nuclear material. The Division ensures that such exports conform to national policy objectives and assists in implementing Canada's bilateral nuclear co-operation agreements. Export controls are exercised in conjunction with External Affairs and International Trade Canada and are also applied to certain equipment, technology and other materials. Controls are applied also to imports of nuclear material and heavy water in order that Canada may fulfil any treaty obligations to supplier countries, meet any IAEA requirements and ensure that any domestic health, safety and security requirements are in place. In 1988, 580 export and import licences were issued.

Canada has nuclear co-operation agreements with 28 countries, which the Division administers. In addition, there are specific agreements on certain facilities for which the Division must also handle administrative matters. This task involves consultations with AECB counterparts in these countries. Division staff also participate in formal country-to-country consultations on nuclear matters led by

External Affairs and International Trade Canada.

The Facility Operators' Role in Safeguards

Nuclear facility operators in Canada have obligations that stem directly from the Atomic Energy Control Regulations and the NPT in that they must regularly report material transfers to the AECB. The staff required to undertake these reporting requirements and prepare for inventory checks varies according to the scale of the operation. Larger facilities require a nuclear material control group to process and report on the almost daily transfers. Additional services to the IAEA are provided by larger facility operators on a continuing basis, free of charge. These services include the provision of:

- access to the facility for the inspection of nuclear material records and the servicing and maintenance of installed safeguards equipment;
- escorts for inspections and the provision of required health and safety equipment;
- external power and climate control for IAEA-designated instrumentation;
- continuous and adequate lighting for satisfactory operation of IAEA surveillance cameras (if installed); and
- office space during inspections for IAEA inspectors conducting audits of facility records.

The contact persons designated for the larger facilities spend a considerable amount of their time concerned with these activities. Co-ordinating IAEA equipment installation and maintenance, when required, is particularly time consuming when installation is undertaken by the facility itself, because the contact person becomes responsible for the preparation of the necessary work authorizations and schedules.

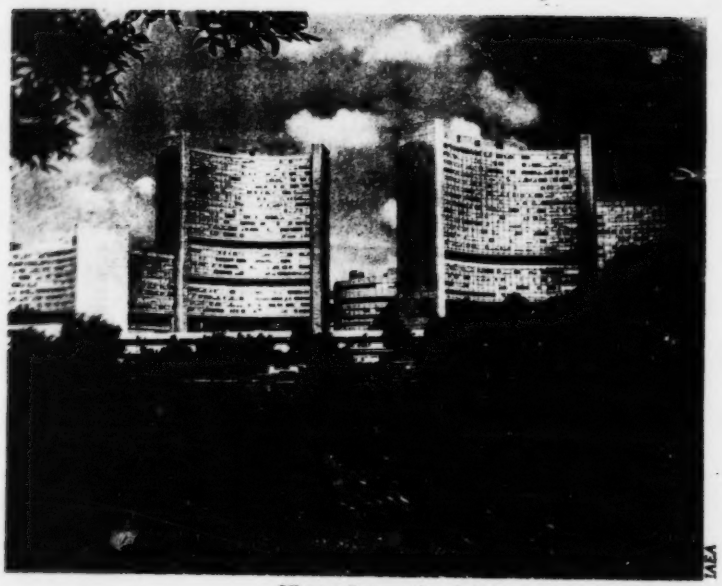
Table 3 Facility Personnel in Support of IAEA Safeguards Inspections in Canada, 1987

This table estimates the effort that nuclear facilities must employ to accommodate IAEA inspections. It does not cover the effort required to maintain Canada's system of nuclear accounting.

Facility	IAEA Person Days	Ratio, Facility to IAEA Person Days	Estimated Facility Person Days (rounded)
CANDU Reactors	864	1.5:1	1 300
Fuel Fabrication Plants	50	2:1	100
AECL Research Co.	166	2:1	330
Others	38	2:1	80
TOTALS	1 118		1 800

Source: E. Payne, "National Infrastructure for Implementing IAEA Safeguards Obligations" in *International Atomic Energy Agency Safeguards as a Model For Verifying a Chemical Weapons Convention: Proceedings of a Workshop Held at Banff, Alberta,* Arms Control Verification Occasional Papers, No. 3, (Ottawa: Department of External Affairs, 1989).

Figure 9 IAEA Headquarters



Vienna International Centre where the IAEA is headquartered.

Chapter 3

The Canadian Safeguards Support Program

History and Background
Maintaining the safeguards inspection system and purchasing the equipment and supplies with which to carry out inspections consumes a third of the regular budgetary contributions of IAEA members. To develop new equipment and techniques to enhance the effectiveness of the safeguards system, the IAEA depends almost entirely upon supplementary support from 12 member countries and organizations, including Canada. The total value of this extra support has been estimated to be approximately half of the regular safeguards budget.

In 1976, Canada decided to establish what became one of the first IAEA safeguards support programs. The primary aim of this program was to assist the IAEA in developing and supplying advanced safeguards systems and equipment to augment the, then, rudimentary safeguards applied to Canadian Deuterium Uranium (CANDU) power reactors and Canadian-designed research reactors, both in Canada and abroad.

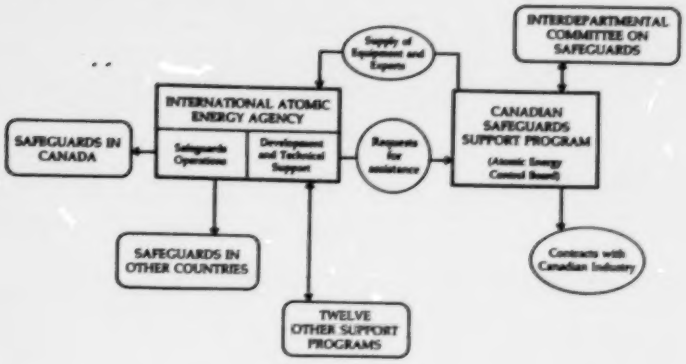
Objectives
The overall objective of the Canadian Safeguards Support Program is to help the IAEA by providing technical assistance and other resources and by developing equipment to improve the effectiveness of IAEA safeguards. The more specific objectives are:

- to enable Canada to participate effectively in measures for the international control of nuclear energy;
- to enable the IAEA to provide effective international safeguards for Canadian-supplied nuclear material and facilities; and
- to enhance the credibility of the IAEA international inspection function generally and through this, the credibility of Canadian nuclear export and non-proliferation policy.

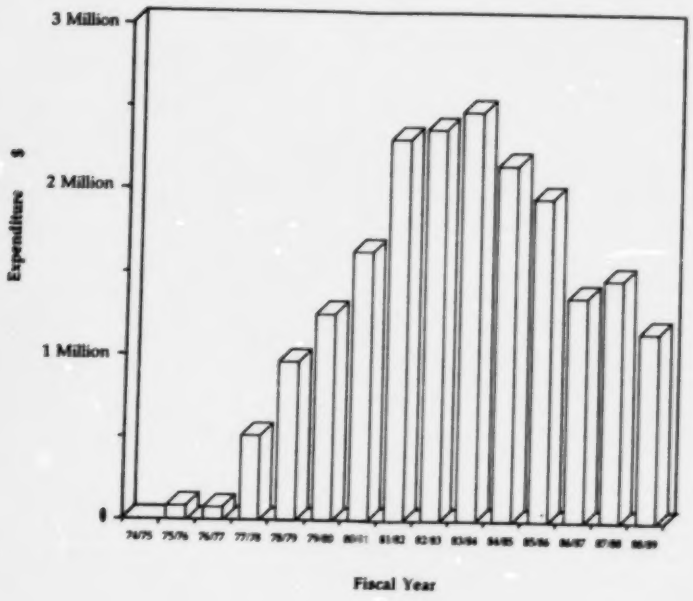
Organization and Scope
When first established, the Safeguards Support Program was under the joint management of the Atomic Energy Control Board (AECB) and Atomic Energy of Canada Limited (AECL) — a Canadian Crown corporation. The AECB provided the expertise relating to IAEA safeguards. AECL provided half of the funding and much of the technical expertise as well as the facilities for the development tasks. In 1989, the Program was reorganized and the AECB became responsible for all project and financial management. Research and development are now carried out through contracts

Figure 10 Canadian Safeguards Support Program: Organization and Expenditures

Organization



Expenditures



with companies in the private sector, as well as with AECL.

The Program operates under the direction of the Interdepartmental Committee on Safeguards (ICS) which is formed by representatives from External Affairs and International Trade Canada and the AECB. The role of the ICS is to ensure that tasks undertaken by the Support Program are consistent with Canadian policy on non-proliferation, with Canada/IAEA safeguards agreements for safeguards implementation, and are operationally feasible. The ICS also advises on many aspects of safeguards implementation and development.

In 1983, the scope of the Canadian Safeguards Support Program was extended beyond nuclear reactors to include other facilities, such as nuclear fuel plants and reprocessing plants which separate and recover plutonium from irradiated fuel. Although Canada does not have fuel reprocessing plants, it does fabricate fuel and it is the world's largest exporter of uranium. It, therefore, has a strong and continuing interest in ensuring that uranium supplied to other countries is well safeguarded.

Program Tasks

The Canadian Safeguards Support Program carries out tasks that are requested by the IAEA. These tasks fall into three groups.

1. Development of Safeguards Approaches

For every facility at which safeguards are applied by the IAEA, the Agency first conducts an analysis of potential diversion techniques that a country might employ to divert nuclear materials to building weapons. It then determines the approach that the Agency will take to detect, and thereby deter, such diversion of nuclear material. These analyses are known as systems studies. Through the Canadian Safeguards Support Program, assistance has been given to the IAEA to carry out such systems studies and to design the safeguards approaches for nuclear facilities of Canadian design. This assistance has been given mainly through the provision of "cost-free" experts but also through the provision of drawings, technical information, and the results of studies carried out in Canada.

Safeguards is a mixture of art and science conducted within a legal framework. It is also a relatively recent development. Therefore, safeguards approaches must be reviewed periodically in response to

advances in technology and the evolution of the technical safeguards implementation criteria used by the IAEA. For example, a review of the original approaches for the multi-unit CANDU stations at Pickering, Bruce and Darlington, Ontario, resulted in more emphasis being placed on safeguarding the fuel in the reactor cores and in the development of special instrumentation to achieve this objective. The Canadian Safeguards Support Program provides assistance to the IAEA in carrying out such reviews.

2. Cost-free Experts

The provision of cost-free experts is acknowledged by the IAEA as a most cost-effective means of assistance. It involves providing Canadians free of charge to work for the IAEA, mostly in Vienna, but sometimes in Canada. The advantage to the IAEA is that a source of expertise is provided for short-term projects requiring particular knowledge or special skills for which it is impractical to use regular IAEA staff employed on more general long-term projects.

3. Equipment Design and Development

Once the systems studies have been carried out and the safeguards approaches agreed, it is necessary to design and develop appropriate equipment to implement these approaches. This is a complex and challenging undertaking. Depending on the application, an instrument or device may have to operate in a hostile environment such as the high radiation field of a reactor vault or completely under water in a storage pool full of irradiated fuel. The equipment must always be safe, effective and easy to use.

Equipment used to keep nuclear materials under seal and under surveillance must be designed to operate completely without attention and without failure between inspection visits. "Failure" in this context includes giving false alarms due to equipment malfunction as well as being unable to detect diversions. False alarms can lead to costly reverification of nuclear materials under safeguards. In addition to this, designers are faced with the very special demand that this kind of equipment must also be designed to resist or reveal any attempt to tamper with it by a country seeking to cover a diversion. These requirements impose severe limitations on the use of standard industrial equipment and generally mean that each new piece of equipment must be specially designed or adapted.

All prototype equipment developed under the Program, complete with drawings and manuals, is given to the IAEA for its use, free of any conditions. Some of the most important pieces of equipment developed by Canada are shown in Figure 7.

Achievements and Impact

The Canadian Safeguards Support Program has achieved a large measure of success in assisting the IAEA to develop a comprehensive safeguards approach for the CANDU reactor. Accomplishments achieved so far and, in particular, the success of the schemes implemented at the two Canadian and two offshore CANDU 600 MW reactors have permitted increased assurance that CANDU reactors are fully safeguarded. Although the basic approach has been demonstrated, it remains to be fully implemented at some facilities. Work is continuing to make equipment that is more reliable, "user-friendly" and durable.

The IAEA has standardized its safeguards approaches for several types of nuclear facilities which it safeguards. Of these, three relate to various designs of CANDU reactors and are based on Canadian work under the Canadian Safeguards Support Program. Such standardized systems greatly simplify the IAEA's work. The pieces of equipment developed to help implement these safeguards schemes have now been accepted by the IAEA, five foreign governments and three Canadian utilities.

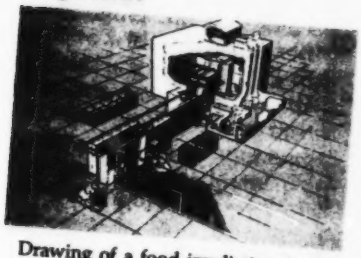
The Canadian Safeguards Support Program has also given valuable assistance to the IAEA in areas of international safeguards not specifically related to Canadian developed nuclear facilities, and some safeguards equipment developed by the Program for CANDU reactors may be applied to safeguarding other types of nuclear facilities in other IAEA member countries. In addition, the IAEA has identified a number of safeguards areas and new tasks for which Canadian expertise could be particularly helpful. These include the development of safeguards approaches and equipment for other nuclear facilities in or being developed by Canada, and for nuclear material in long-term (deep geological) disposal.

The IAEA is constantly upgrading its safeguards criteria to improve the effectiveness and credibility of international safeguards. Consequently, safeguards requirements are continually evolving and are a moving target in all areas, not just CANDU reactors. It is

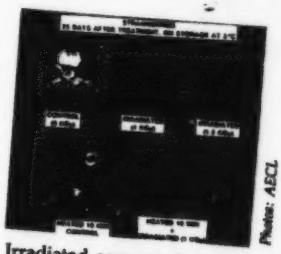
apparent that the IAEA will require the assistance of support programs such as Canada's for the foreseeable future.

Figure 11 More Peaceful Uses of Nuclear Energy

Agriculture



Drawing of a food irradiation facility.

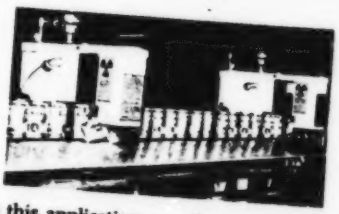


Photos: AECL

Irradiated compared to non-radiated Food.

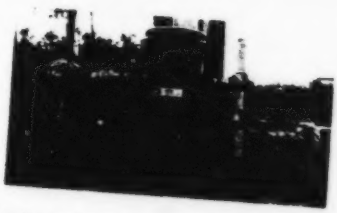
Industry

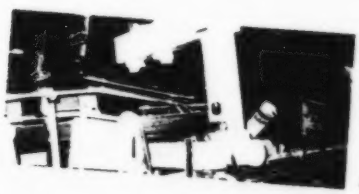
Using a radioactive source, a detector measures the liquid level inside cans permitting partially full cans to be rejected.



In this application, a radioactive source is used to expose x-ray film to check welds and piping for imperfections. This picture shows an industrial radiography "camera" in operation on petroleum pipelines.

This density gauge is used to detect changes in liquid flow inside pipes. The same pipe is being used here to transfer different types of petroleum products. The gauge tells the operator when the transfer of one product ends and the next begins.





The device in this picture measures the amount of material passing along a conveyor belt in order to optimize mineral processing.

Photos: AECB

Conclusion

The Non-Proliferation Treaty came into force in 1970 with its ratification by 40 countries. Today, about 100 more nations have signed the NPT. While the failure of some countries with a nuclear capability to sign the Treaty remains a serious ongoing concern, President John F. Kennedy's pessimistic prediction of a world populated by 15 to 20 nuclear weapons states by 1975 has not come true. By creating legal barriers against proliferation and by promoting an international non-proliferation ethic, the NPT can be legitimately called a major success in promoting international peace and security. A key ingredient of this success has been the confidence generated through verification by IAEA safeguards.

The growth of IAEA safeguards, since their modest beginnings in the 1960s, has been considerable. By the end of 1988, IAEA safeguards agreements had been concluded with about 100 countries, including Canada, and as a result of extensive safeguards coverage under NPT and non-NPT agreements, over 500 nuclear facilities worldwide are under safeguards or containing safeguarded nuclear material.

It is primarily the existence of this credible and effective safeguards system that makes today's international trade in nuclear equipment and materials possible. It is safeguards that monitors the transfer of nuclear technology to developing countries as well as between industrial countries. Very little, if any, trade or transfer would take place without the non-proliferation assurances provided by IAEA safeguards.

Canada's commitment to nuclear non-proliferation and IAEA safeguards remains unwavering. This commitment is demonstrated by the fact that, today, Canada's nuclear non-proliferation policy is among the strictest in the world. In addition, Canada has made a major contribution to strengthening the credibility of IAEA safeguards through co-operation in the application of safeguards at facilities in Canada and through the work of the Canadian Safeguards Support Program. Few countries can claim as significant a role over such a long time.

At times Canada has paid a commercial price as a result of its leading role in nuclear non-proliferation. However, the Canadian government in a policy announcement in December 1976 clearly stated that:

> *. . . we are prepared to accept the commercial consequences of being clearly ahead of other*

suppliers. This is the price we are prepared to pay to curb the threat to mankind of nuclear proliferation.

Canada will continue to work to persuade other countries to accede to the NPT and to accept full scope IAEA safeguards. It will continue to try to convince other nuclear suppliers to make such a commitment a condition for nuclear cooperation. It will persist in its efforts to strengthen IAEA safeguards, particularly through the Canadian Safeguards Support Program. It will also continue to examine Canadian policy with a view to strengthening the international nonproliferation regime. Finally, at future reviews of the Treaty, Canada will strive to ensure that these conferences are successful and that the Treaty remains effective into the future.

Figure 12 Further Reading

International Atomic Energy Agency. *IAEA Safeguards: An Introduction*. Vienna: 1981.

International Atomic Energy Agency. *IAEA Safeguards: Aims, Limitations, Achievements*. Vienna: 1983.

International Atomic Energy Agency. "The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons." INFCIRC/153 (Corrected), Vienna: 1983.

Canada's Nuclear Non-Proliferation Policy. Ottawa: External Affairs and International Trade Canada, 1985.

International Atomic Energy Agency Safeguards as a Model for Verification of a Chemical Weapons Convention: Proceedings of a Workshop Held at Banff Springs Hotel, Alberta, Canada, October 21–24, 1988. Arms Control Verification Occasional Papers, no. 3. Edited by H. Bruno Schiefer and James F. Keeley. Ottawa: External Affairs and International Trade Canada, 1989.

Statute of the International Atomic Energy Agency. 1956.

Appendix
Treaty on the Non-Proliferation of Nuclear Weapons

Opened for Signature: July 1, 1968
Entered into Force: March 5, 1970
Number of Parties as of October 1, 1989: 140

Text:

The States concluding this Treaty, hereinafter referred to as the "Parties to the Treaty,"

Considering the devastation that would be visited upon all mankind by a nuclear war and the consequent need to make every effort to avert the danger of such a war and to take measures to safeguard the security of peoples,

Believing that the proliferation of nuclear weapons would seriously enhance the danger of nuclear war,

In conformity with resolutions of the United Nations General Assembly calling for the conclusion of an agreement on the prevention of wider dissemination of nuclear weapons,

Undertaking to cooperate in facilitating the application of International Atomic Energy Agency safeguards on peaceful nuclear activities,

Expressing their support for research, development and other efforts to further the application, within the framework of the International Atomic Energy Agency safeguards system, of the principle of safeguarding effectively the flow of source and special fissionable materials by use of instruments and other techniques at certain strategic points,

Affirming the principle that the benefits of peaceful applications of nuclear technology, including any technological by-products which may be derived by nuclear-weapon States from the development of nuclear explosive devices, should be available for peaceful purposes to all Parties of the Treaty, whether nuclear-weapon or non-nuclear-weapon States,

Convinced that, in furtherance of this principle, all Parties to the Treaty are entitled to participate in the fullest possible exchange of scientific information for, and to contribute alone or in cooperation with other States to, the further development of the applications of atomic energy for peaceful purposes,

Declaring their intention to achieve at the earliest possible date the cessation of the nuclear arms race and to undertake effective measures in the direction of nuclear disarmament,

Urging the cooperation of all States in the attainment of this objective,

Recalling the determination expressed by the Parties to the 1963 Treaty banning nuclear weapon tests in the atmosphere, in outer space and under water in its Preamble to seek to achieve the discontinuance of all test explosions of nuclear weapons for all time and to continue negotiations to this end,

Desiring to further the easing of international tension and the strengthening of trust between States in order to facilitate the cessation of the manufacture of nuclear weapons, the liquidation of all their existing stockpiles, and the elimination from national arsenals of nuclear weapons and the means of their delivery pursuant to a treaty on general and complete disarmament under strict and effective international control,

Recalling that, in accordance with the Charter of the United Nations, States must refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any State, or in any other manner inconsistent with the Purposes of the United Nations, and that the establishment and maintenance of international peace and security are to be promoted with the least diversion for armaments of the world's human and economic resources.

Have agreed as follows:

Article I

Each nuclear-weapon State Party to the Treaty undertakes not to transfer to any recipient whatsoever nuclear weapons or other nuclear explosive devices or control over such weapons or explosive devices directly, or indirectly; and not in any way to assist, encourage, or induce any non-nuclear-weapon State to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or explosive devices.

Article II

Each non-nuclear-weapon State Party to the Treaty undertakes not to receive the transfer from any transferor whatsoever of nuclear weapons or other nuclear explosive devices or of control over such weapons or explosive devices directly, or indirectly; not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices; and not to seek or receive any assistance in the manufacture of nuclear weapons or other nuclear explosive devices.

Article III

1. Each non-nuclear-weapon State Party to the Treaty undertakes to accept safeguards, as set forth in an agreement to be negotiated and concluded with the International Atomic Energy Agency in accordance with the Statute of the International Atomic Energy Agency and the Agency's safeguards system, for the exclusive purpose of verification of the fulfilment of its obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices. Procedures for the safeguards required by this article shall be followed with respect to source or special fissionable material whether it is being produced, processed or used in any principal nuclear facility or is outside any such facility. The safeguards required by this article shall be applied on all source or special fissionable material in all peaceful nuclear activities within the territory of such State, under its jurisdiction, or carried out under its control anywhere.

2. Each State Party to the Treaty undertakes not to provide:
   (a) source or special fissionable material, or

(b) equipment or material especially designed or prepared for the processing, use or production of special fissionable material, to any non-nuclear-weapon State for peaceful purposes, unless the source or special fissionable material shall be subject to the safeguards required by this article.

3. The safeguards required by this article shall be implemented in a manner designed to comply with Article IV of this Treaty, and to avoid hampering the economic or technological development of the Parties or international cooperation in the field of peaceful nuclear activities, including the international exchange of nuclear material and equipment for the processing, use or production of nuclear material for peaceful purposes in accordance with the provisions of this article and the principle of safeguarding set forth in the Preamble of the Treaty.

4. Non-nuclear-weapon States Party to the Treaty shall conclude agreements with the International Atomic Energy Agency to meet the requirements of this article either individually or together with other States in accordance with the Statute of the International Atomic Energy Agency. Negotiation of such agreements shall commence within 180 days from the original entry into force of this Treaty. For States depositing their instruments of ratification or accession after the 180-day period, negotiation of such agreements shall commence not later than the date of such deposit. Such agreements shall enter into force not later than eighteen months after the date of initiation of negotiations.

Article IV

1. Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties of the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty.

2. All the Parties to the Treaty undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also cooperate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world.

Article V

Each party to the Treaty undertakes to take appropriate measures to ensure that, in accordance with this Treaty, under appropriate international observation and through appropriate international procedures, potential benefits from any peaceful applications of nuclear explosions will be made available to non-nuclear-weapon States Party to the Treaty on a non-discriminatory basis and that the charge to such Parties for the explosive devices used will be as low as possible and exclude any charge for research and development. Non-nuclear-weapon States Party to the Treaty shall be able to obtain such benefits, pursuant to a special international agreement or agreements, through an appropriate international body with adequate representation of non-nuclear-weapon States. Negotiations on this subject shall commence as soon as possible after the Treaty enters

into force. Non-nuclear-weapon States Party to the Treaty so desiring may also obtain such benefits pursuant to bilateral agreements.

Article VI

Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control.

Article VII

Nothing in this Treaty affects the right of any group of States to conclude regional treaties in order to assure the total absence of nuclear weapons in their respective territories.

Article VIII

1. Any Party to the Treaty may propose amendments to this Treaty. The text of any proposed amendment shall be submitted to the Depositary Governments which shall circulate it to all Parties to the Treaty. Thereupon, if requested to do so by one-third or more of the Parties to the Treaty, the Depositary Governments shall convene a conference, to which they shall invite all the Parties to the Treaty, to consider such an amendment.

2. Any amendment to this Treaty must be approved by a majority of the votes of all the Parties to the Treaty, including the votes of all nuclear-weapon States Party to the Treaty and all other Parties which, on the date the amendment is circulated, are members of the Board of Governors of the International Atomic Energy Agency. The amendment shall enter into force for each Party that deposits its instrument of ratification of the amendment upon the deposit of such instruments of ratification by a majority of all the Parties, including the instruments of ratification of all nuclear-weapon States Party to the Treaty and all other Parties which, on the date the amendment is circulated, are members of the Board of Governors of the International Atomic Energy Agency. Thereafter, it shall enter into force for any other Party upon the deposit of its instrument of ratification of the amendment.

3. Five years after the entry into force of this Treaty, a conference of Parties to the Treaty shall be held in Geneva, Switzerland, in order to review the operation of this Treaty with a view to assuring that the purposes of the Preamble and the provisions of the Treaty are being realized. At intervals of five years thereafter, a majority of the Parties to the Treaty may obtain, by submitting a proposal to this effect to the Depositary Governments, the convening of further conferences with the same objective of reviewing the operation of the Treaty.

Article IX

1. This Treaty shall be open to all States for signature. Any State which does not sign the Treaty before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.

2. This Treaty shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland and the Union of Soviet Socialist Republics, which are hereby designated the Depositary Governments.

3. This Treaty shall enter into force after its ratification by the States, the Governments of which are designated Depositaries of the Treaty, and forty other States signatory to this Treaty and the deposit of their instruments of ratification. For the purposes of this Treaty, a nuclear-weapon State is one which has manufactured and exploded a nuclear weapon or other nuclear explosive device prior to January 1, 1967.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of the Treaty, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or of accession, the date of the entry into force of this Treaty, and the date of receipt of any requests for convening a conference or other notices.

6. This Treaty shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.

Article X

1. Each Party shall in exercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject matter of this Treaty, have jeopardized the supreme interests of its country. It shall give notice of such withdrawal to all other Parties to the Treaty and to the United Nations Security Council three months in advance. Such notice shall include a statement of the extraordinary events it regards as having jeopardized its supreme interests.

2. Twenty-five years after the entry into force of the Treaty, a conference shall be convened to decide whether the Treaty shall continue in force indefinitely, or shall be extended for an additional fixed period or periods. This decision shall be taken by a majority of the Parties to the Treaty.

Article XI

This Treaty, the English, Russian, French, Spanish and Chinese texts of which are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of this Treaty shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding States.

IN WITNESS WHEREOF the undersigned, duly authorized, have signed this Treaty.

DONE in triplicate at the cities of London, Moscow and Washington, the first day of July, one thousand nine hundred and sixty-eight.

In a press release on November 28, 1989, Dr. René J.A. Lévesque, president of the Atomic Energy Control Board (AECB), announced that "the government has approved additional resources for the agency amounting to 93 staff positions and a total of $25.4 million over the next two and a half years. The AECB's current annual budget is approximately $26 million, and it has an authorized complement of 267." This increase is to ensure that "the resources available to the agency keep pace with the advances and developments in the nuclear industry." Included in the new AECB budget is $3.5 million per annum for the Canadian Safeguards Support Program as well as a total of four person years.

Verification Brochures

No. 1 *Seismic Verification*, 1986
No. 2 *The PAXSAT Concept*, 1987
No. 3 *Verification Research*, 1987
No. 4 *Cruise Missiles*, 1988

External Affairs and International Trade Canada
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